Process Evaluation Section

Materials Recovery from Auto Shredder Residue

Problem/Opportunity

U.S. auto shredders generate about 5 million tons of auto shredder residue (ASR) annually. Similar amounts are generated in Europe and in the Pacific Rim. Because of the lack of a cost-effective technology to recycle this waste, it is mostly landfilled; smaller amounts are incinerated.

Approach

The purpose of this project, sponsored by the U.S. Department of Energy (DOE) and conducted under a Cooperative Research and Development Agreement (CRADA) with the Vehicle Recycling Partnership (composed of Ford, GM and Daimler-Chrysler) and the American Plastics Council, was to develop a technology to recover recyclable materials from ASR. Our basic approach was to process the ASR as if it was a mineral ore. Thus, the ASR is first separated into three primary fractions, then recyclable materials are recovered from these three fractions.

Results

Bulk Separation

Bulk separation of the ASR is accomplished by using a mechanical separation system that includes a unique two-stage trommel designed at Argonne (Figure 1). Bulk separation yields a plastics concentrate (about 45 wt.% of ASR), a polyurethane foam fraction (about 10 wt.% of ASR) and an oxides fraction (about 45 wt.% of ASR). A 2-ton/h pilot unit was built and installed at Argonne.

Figure 1. This 2-ton/h bulk separation system effectively separates ASR into three fractions: polyurethane foam, plastics concentrate, and an oxides fraction.

Foam Recovery

The polyurethane foam that is recovered from the shredder residue contains entrained dirt and automotive fluids. Argonne developed and patented a process for producing a clean polyurethane foam that meets the requirements of the existing foam "rebond" market. A 100-lb/h foam cleaning process was built and pilot tested at a shredder site (Figure 2). More than 10 tons of cleaned foam were recovered and supplied to customers for product evaluation. The recovered foam was rebonded and used to produce carpet padding for automotive applications. The product met all of the performance requirements of the rebonders and their automotive customers.

The bulk separation technology and the foam processing technology developed by Argonne have been licensed to Salyp N.V. of Belgium. A full-scale commercial demonstration plant

has been built and successfully operated at Salyp's facilities in Ieper, Belgium.

Figure 2. The foam is cleaned and dried in a continuous linear wash, rinse, and dry system. The system shown is a 100-lb/h pilot unit.

Plastic Concentrate

There are more than 50 different types of polymers used in automotive applications today; shredder residue contains all of them as well as other classes of polymers that are used in metal-bearing scrap (e.g., obsolete appliances) that the shredder might process. Through bench-scale research, we have been able to separately recover those plastics that are present in the largest volumes and/or have the highest potential values. The plastics are separated by means of a froth-flotation technology that we originally developed for other plastics separations. Polymers that we have recovered from shredder residue include polyethylene, polypropylene, acrylonitrile butadiene styrene, high-impact polystyrene, PVC, EPDM, and nylons.

Oxide Fraction

The oxide fraction, which includes particles measuring less than about 5/8 in., contains metal oxides, glass, dirt, and some organics. Magnetic separation of the oxide fraction yielded a high-quality iron oxide that meets the feed requirements of the cement industry for iron units. During a pilot demonstration at a shredder facility, we produced about 50 tons of this material to be used for testing by the cement industry.

Future Plans

Since the bulk separation technology and the foam processing technology developed by Argonne have been licensed to Salyp N.V. of Belgium and the full-scale commercial demonstration plant has been built, Salyp is marketing these technologies through franchise operations on a worldwide basis. We are continuing to assist Salyp in improving these technologies, for example, by integrating our plastics separation technology into their system.